Extrusion Progress

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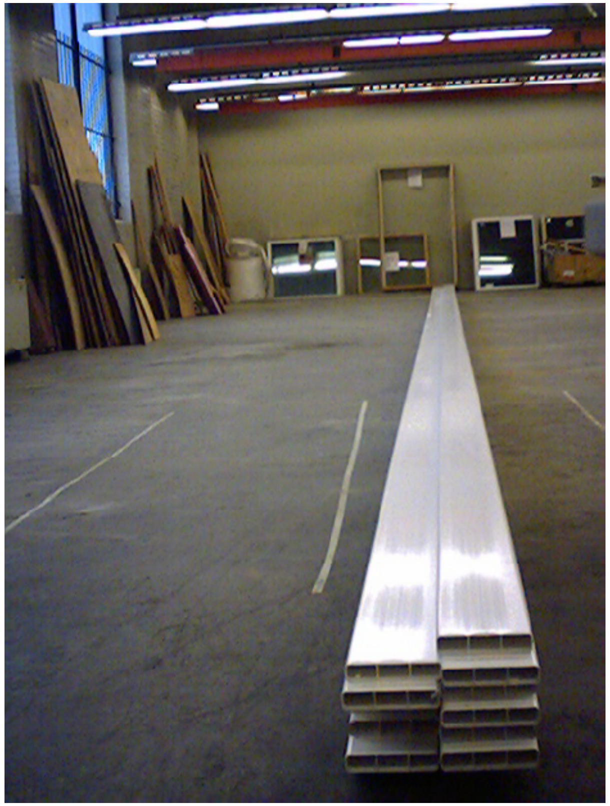


Prototype Extrusions Delivered for Testing

Look beautiful after usual tweeking of process

Mechanically

- Excellent straightness, smoothness, uniformity

Optically

- As predicted for about 12% TiO_2
- Reflectivity measurements – Indiana
- Light yield – Minnesota

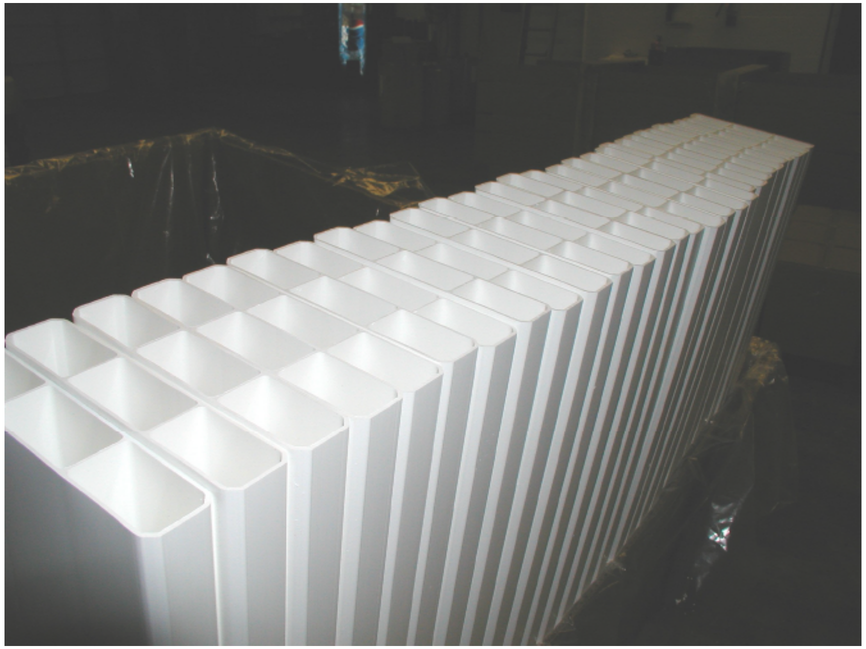
To do with these extrusions:

Light Yields

- Scintillator (Indiana, Minnesota)
- Fiber loop (Minnesota)
- Vertical Slice (Texas, Minnesota)

Mechanical Structure

- Test to destruction (Argonne, Fermilab, Minnesota)
- Check calculations (Argonne, Fermilab, Minnesota)
- Manifolds & seals (Fermilab, Minnesota, Texas)
- Lifetime (Caltech, Indiana)
- Vertical Slice (Texas, Minnesota)



Extrusions Delivered

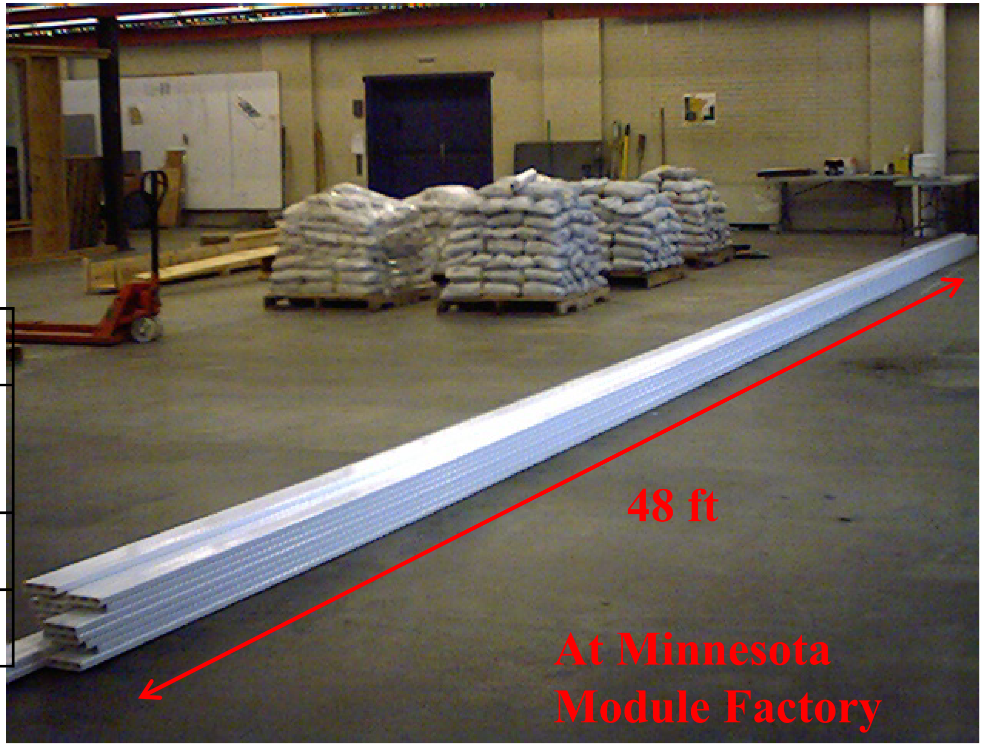
12% TiO_2

Next vertical slice test

Minnesota
Texas

all outer walls mm			all inner webs mm	
ave	1.419		ave	1.113
std dev	0.083		std dev	0.137
min	1.346		min	0.914

Measured by J. Kilmer

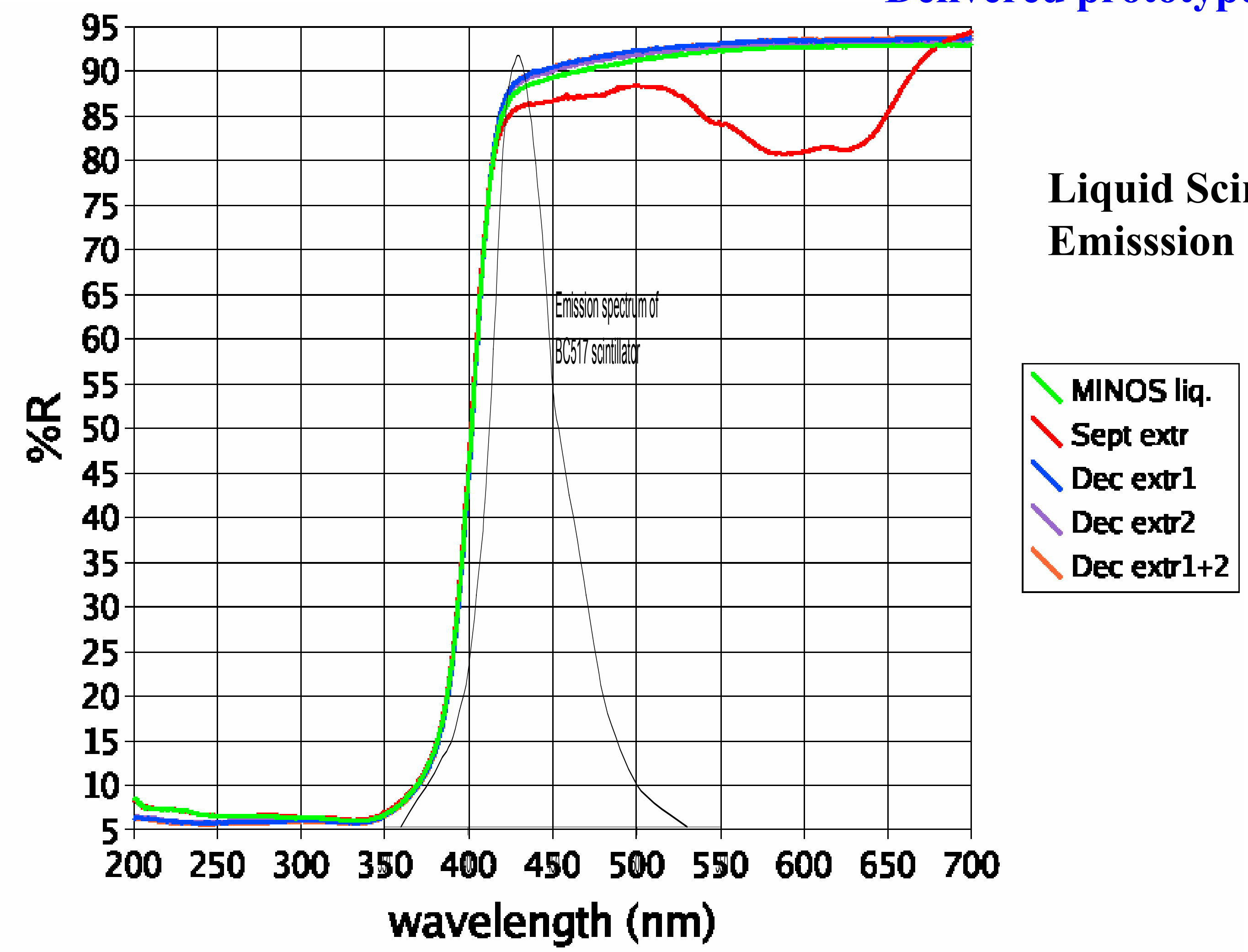


Reflectivity Measurements - Indiana

Old extrusions from MINOS

First pass prototype – low TiO_2

Delivered prototype – 12% TiO_2

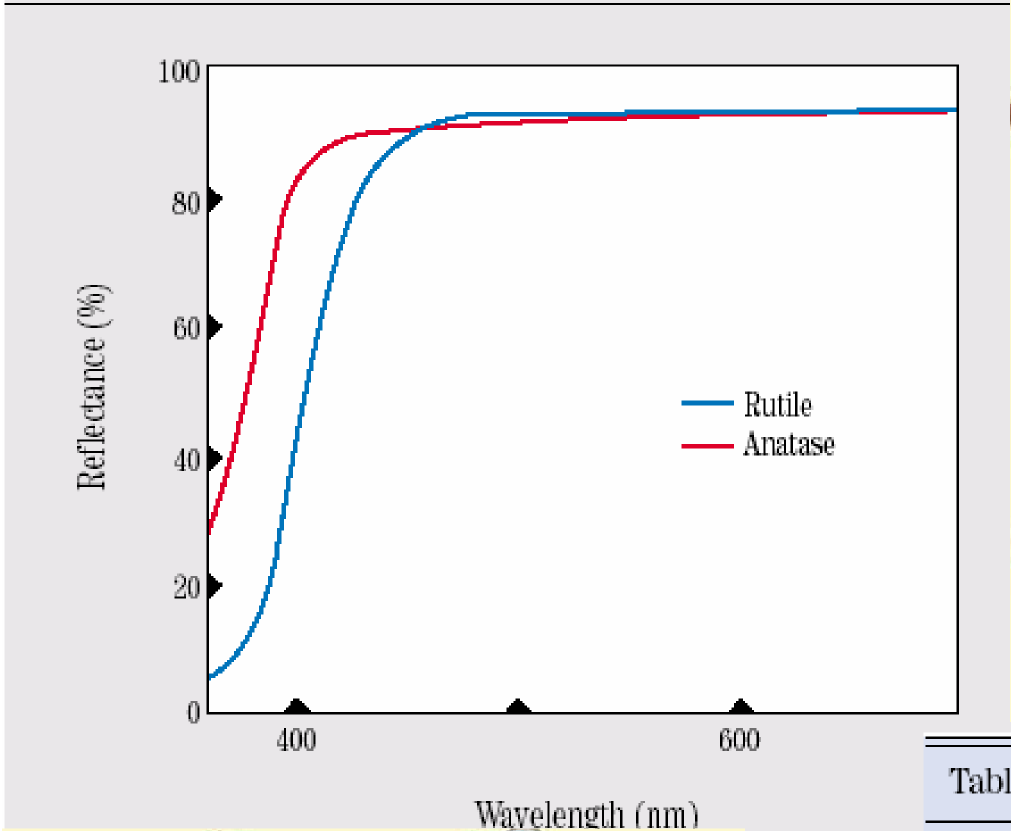


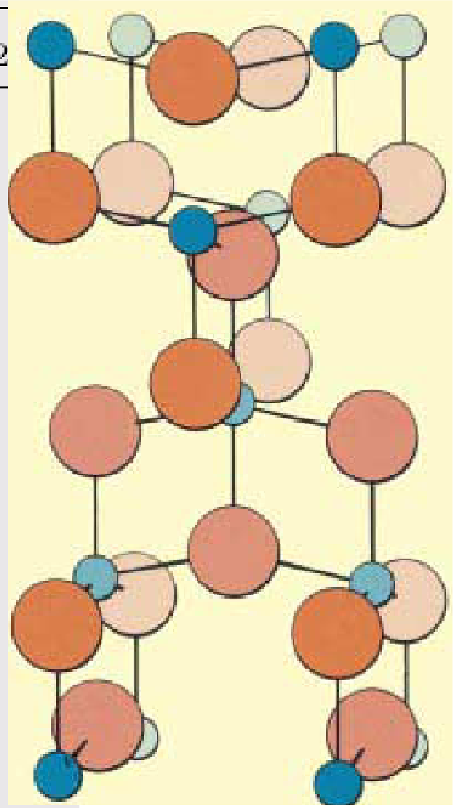
Liquid Scintillator
Emisssion Spectrum

CR-834 IS AN ALUMINA STABILIZED, CHLORIDE PROCESS RUTILE PIGMENT

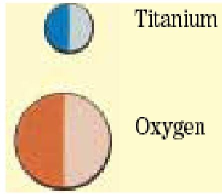
TiO2 types, does it matter?

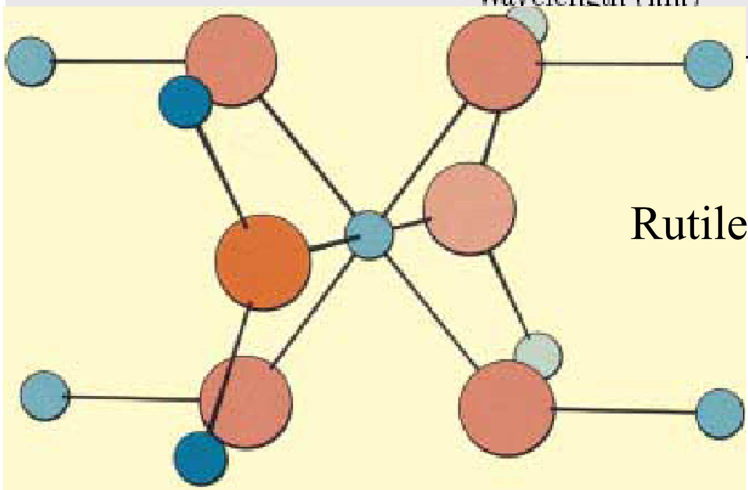
Figure 5 Reflectance spectra from anatase and rutile TiO_2





Anatase crystal





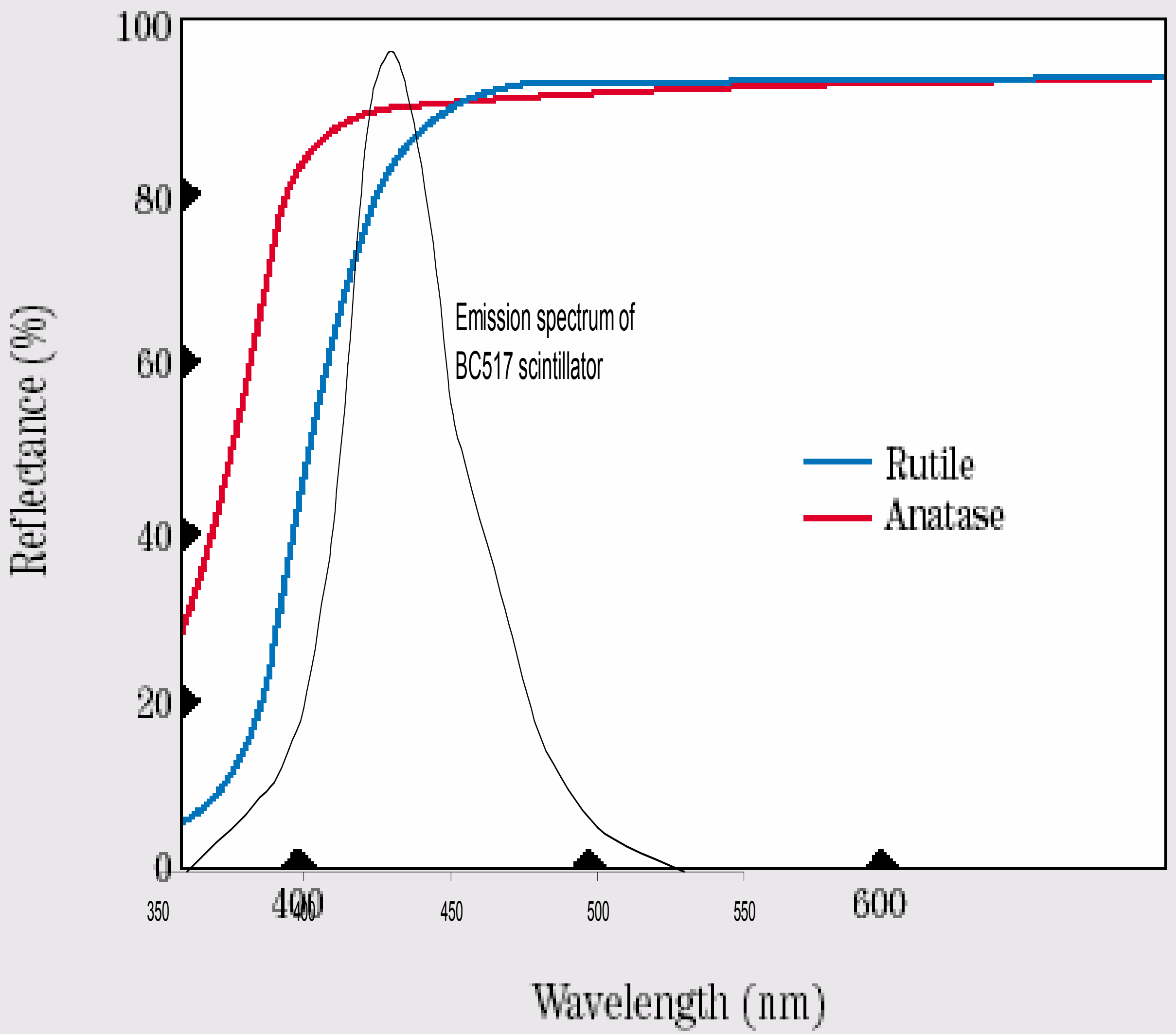
Rutile crystal

Table 1 Refractive indicies of some white pigments

Pigment	Refractive index
Rutile TiO_2	2.70
Anatase TiO_2	2.55
Zinc sulphide	2.37
Antimony oxide	2.30
Lithopone 30%	1.84
Zinc oxide	2.02
White lead	2.00
China clay	1.57

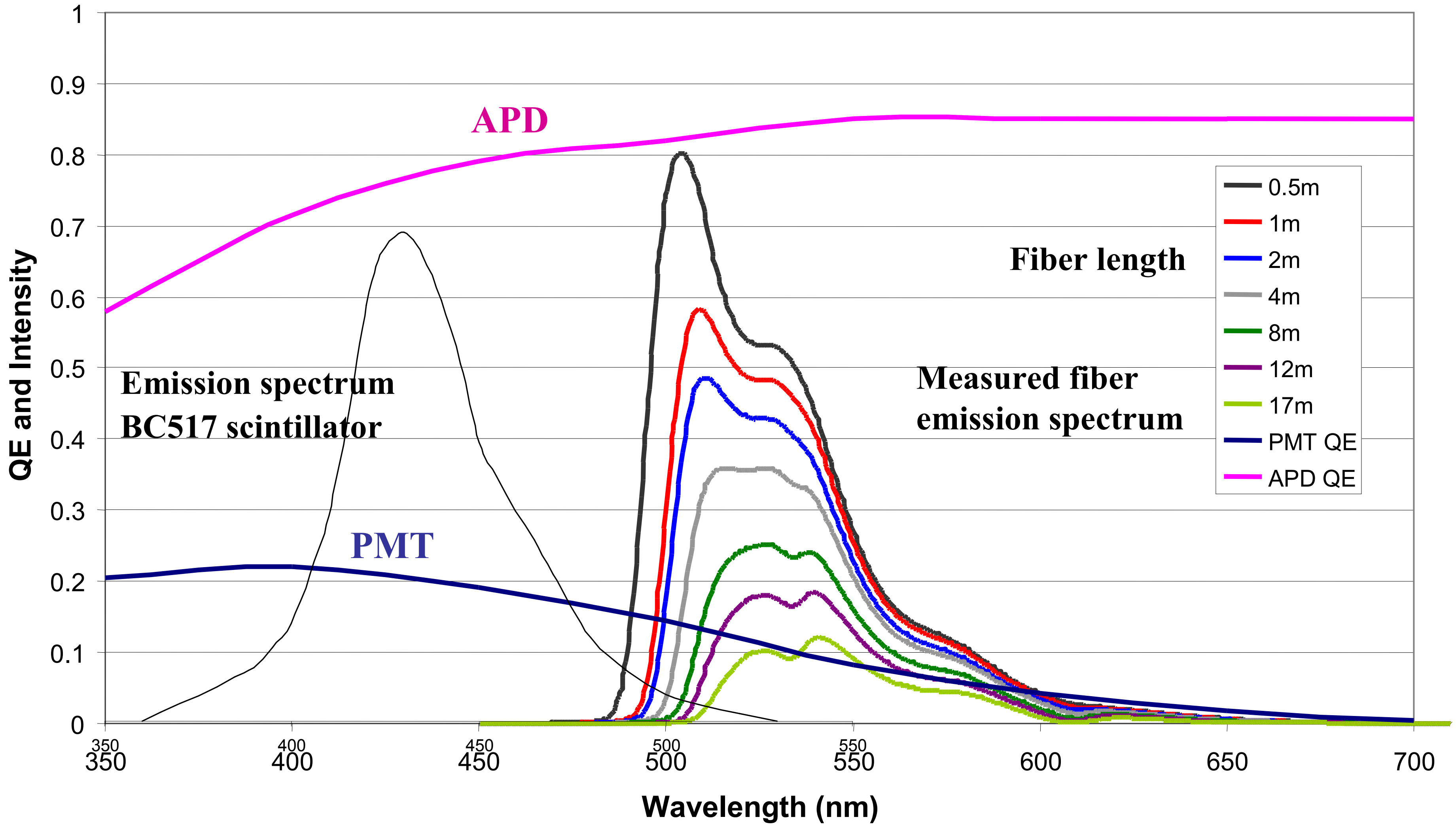
Rutile is the usual pigment

Figure 5 Reflectance spectra from anatase and rutile TiO_2

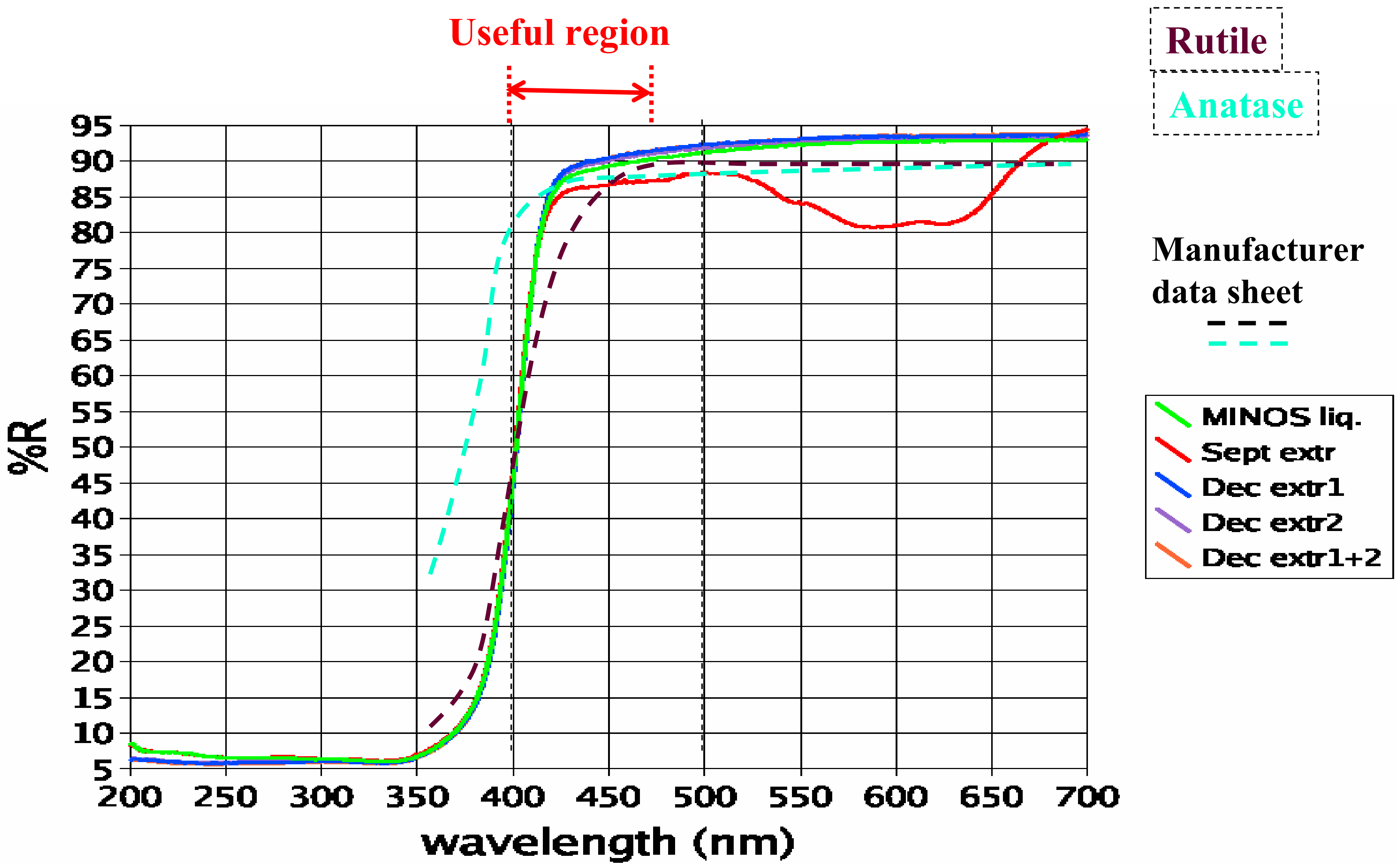


Perhaps we should try Anatase.

Quantum Efficiency and Fiber Emission

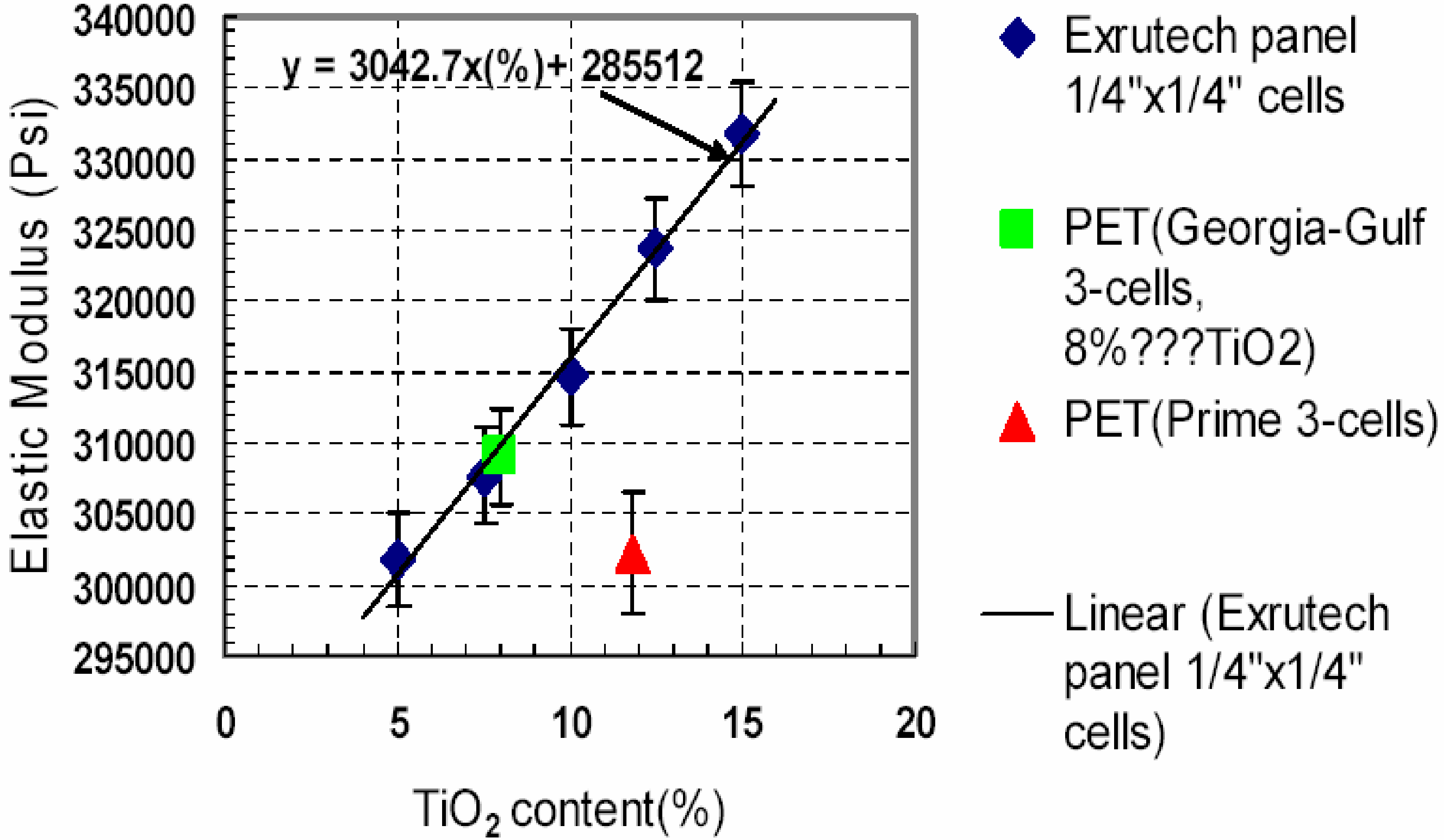


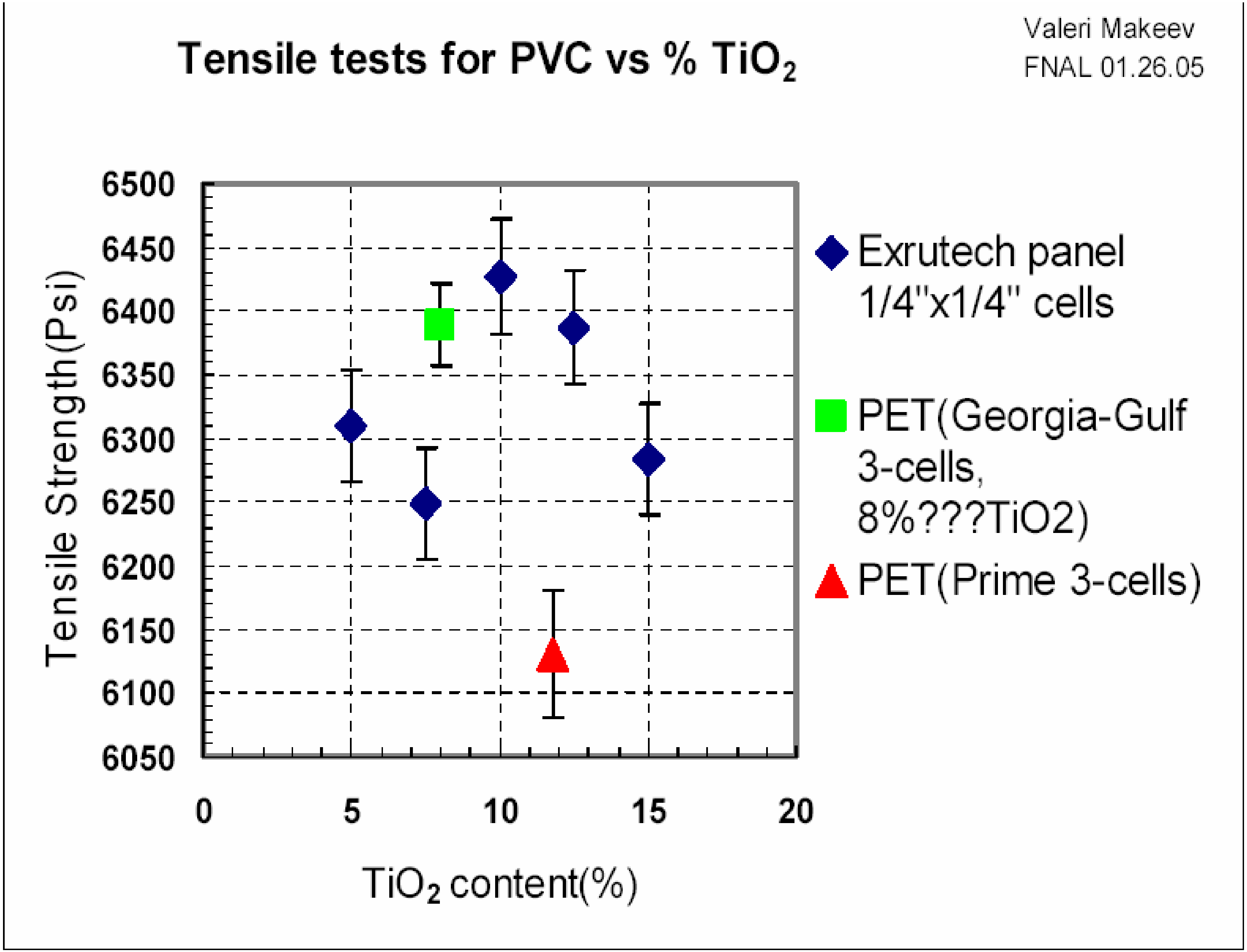
Indiana Measurements vs Manufacturer Specs.



Elastic modulus for PVC vs % TiO_2

Valeri Makeev
FNAL 01.26.05




Tensile tests for PVC vs % TiO_2
Valeri Makeev
FNAL 01.26.05
Tensile Strength(Psi)
6500
6450
6400
6350
6300
6250
6200
6150
6100
6050
0
5
10
15
20
TiO_2 content(%)
Exrutech panel 1/4"x1/4" cells
PET(Georgia-Gulf 3-cells, 8%???TiO2)
PET(Prime 3-cells)

Extrusion Composition (as reported)

Component	Initial Extrusions %	Delivered Extrusions %
PVC Resin	79.0	78.7
TiO_2 (many types, some "coated")	9.5	11.8
acrylic impact modifiers (there are many kinds)	5.0	4.0
fillers (unknown, usually calcium carbonate)	3.0	3.0
internal & external lubricants (unknown, many kinds)	2.5	0.8
organo-tin stabilizers (3 major groups, maybe 20 types)	1.0	1.6

Compiled by J. Cooper

Possible Plan:

Work with current extruder: (short time, small incremental cost)

- **Composition of PVC**
  - **Plastic has additives – Do they matter? (JC)**
- **Composition of TiO_2**
  - **Can we get more light?**

Work with new extruder: (6 months, larger incremental cost)

- **Use cell size and wall thickness for totally active detector**
  - **Physics resolution**
    - **Simulations – Minnesota (LM. PL)**
  - **Mechanical strength**
    - **FEA – Fermilab (AL, HJ)**

Order Next Extrusion (3 cell prototype) – realistic 6 months delivery